VISIBLE SPEECH FORMULA
FOR BRAILLE
by
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Explanatory matter -withdrawn from Henry's official text submitted to Joint Braille Committee: Jan-Feb.'54.

VISIBLE SPEECH FORMULA FOR BRAILLE

The invention of sonography by the French army officer, Charles Barbier, was described in its day as "a process which makes possible communication between the deaf and the blind." From this phonetic code of dots and dashes on embossed paper, a 15-year-old blind boy developed an entirely new and much more legible set of orthographic ciphers, destined to perpetuate the memory of his name.

The only importance now attributed to Barbier's code is the fact that it was tested at the Royal Institution for the Young Blind, in Paris, during the early days of Louis Braille's residence there. Little did the artillery captain surmise how significant for future generations of sightless persons was his stubborn insistence that the instructors at the school listen to his proposals and consider the possibilities of his method of embossing symbols of sound on paper. Little did M'sieur le capitaine foresee that a talented little teen-ager was to conceive and to construct a system of communication bound to outshine anything yet achieved for the blind in the history of the world.

In retrospect, we are gratified to note that both Charles Barbier and Louis Braille had their services to society formally recognized by the French Academy of Sciences more than a hundred years ago.

During the past century the education of the blind has forged ahead by leaps and bounds, largely because of the invention of the braille system of writing. The past 25 years was especially productive of uniformity of coding among various sections of linguistic areas. During the past five years much has been accomplished in the standardization of symbols for similar sounds or letters in as many languages as possible.

At the present time the United Nations Educational, Scientific and Cultural Organisation is ready to publish an exhaustive reference book on the histories and principles of all known braille systems, along with an account of Unesco's own part in promoting the adoption of necessary international standards for world braille.

Educators of the blind are well aware that braille is quite cumbersome, complex, and inconvenient. Yet, in spite of these admissions by expert braillists, it is noteworthy that every attempt to improve the braille coding system has finally wound up by returning to the original alphabet. This seems to have been the best solution to the problem, under the circumstances, since those who organized these efforts to simplify the code pledged themselves in advance to retain the seven-line symmetry of Louis Braille's alphabet.

If we were to consider the construction of an international braille code having horizontal as well as vertical symmetry, we might not be too sure that the ten fundamental signs of the original alphabet constitute the best possible basis of a symmetry pattern. Now, although there are any number of ways in which the 63 symbols can be arranged and designated, there would be no advantage in switching to a new set of values unless such a proposed code promises to syncretize the inter-relation of the letter symbols with the sounds they most frequently represent.

Recently, while experimenting with a "phonetic-sequence-formula" which I had constructed, I found that when applied to the braille dot-combinations a pattern of perfect co-ordination among all relatives in the speech charts results. This means that a re-allocation of interpretations of the various cells (according to the braille code which I have worked out) gives us a fundamentally simple code with no confusion whatever to any transcriber or reader. It eliminates multiple connotations of each of the symbols and still allows for limitless contractions. Furthermore, the new symmetry design allows for number-digit-dots which do not conflict with the letter forms.

INTRODUCTION

Seven years ago I had the happiness of being ordained to the holy priesthood in the Cathedral of Milwaukee. A few weeks prior to ordination our class of seminarians had been treated to a guided tour of the classrooms of St. John's School for the Deaf in that city. The tour was conducted by the chaplain, Father Gehl. Demonstration of the techniques of instruction was provided by the various Sisters with their pupils. Although that experience took place in 1946, the impressions it left with me are still quite profound.

Unfortunately I am unskilled in linguistics and semantics. Yet I do possess an appreciation of the value of phonetics in speech training. It has been my conviction for some time that it must be possible to compile a phonetic index of the words of our language so that the listings would be based upon a pre-arranged sequence of the sounds rather than of the spelling by letters. If this sequence of the phonetic elements is founded on scientific observations it should not be difficult to organize the tabulations so that every word which appears alike in visible speech[1] would be grouped together in the index.

The witnessing of modern methods of instructing deaf children to speak prompted me to search out ways of accelerating the preparation of a phonetic "sequence formula" which would be of practical value. It is almost three years now since I

1-Visible speech is a phonetic translation of audible speech. The art of lip reading, an important channel of communication for the deaf, depends for its visible speech patterns on the observable movements of the speech organs in conversation. Technicians at the Bell Telephone Laboratories use the term "visible speech" in connection with portrayal by pictures of the impression made by speech sounds recorded on magnetic tape. Messages intended for aural perception are converted into a form suitable for visual perception by means of visible speech translators. See Bell Monograph B-1415, pp. 62-73.

B-1415

began attempting to construct a series of the standard phonetic characters in such a manner that the inter-relation of the speech sounds in this series would provide the key to an ideal phonetic index in any language employing these sounds.

My attendance at the 1952 summer meetings of the Volta Speech Association for the Deaf[1] left me convinced that my proposed project would be well worth the effort involved in its production. At this convention[2] there were teachers representing a very high percentage of the major schools for the deaf in North America. The demonstrations of techniques (using actual deaf children) was a wonder to behold.

More than a year ago I determined the order of the consonants as I then envisioned what I was aiming to achieve, but the vowels, semi-vowels and semi-consonants were the source of so much uncertainty that for a long time I wondered whether I would ever unravel the mystery. It is only now that I am able to announce that I have at last completed the table of sequence which I sought to construct. It was finished by Thanksgiving Day, 1953, and for me it was the crowning reward of countless unsuccessful attempts to organize the speech elements in a satisfactory sequence "from a to z."

Phoneticians may be surprised to hear that a brief introduction to the technique of transcribing braille for the blind was instrumental in providing me with a clue enabling me to determine the exact order to be observed among the non-consonant factors in this quest for a reliable sequence of speech sounds.

1-On June 5, 1953, this name was officially changed to include its founder's name. It is now known as the Alexander Graham Bell Speech Association for the Deaf. The Association was founded in 1890 by the inventor of the telephone. Bell, incidentally, was the son and grandson of renowned Edinburgh phoneticians. He himself opened a school for training teachers of speech to the deaf in 1870 at Boston.

2-The theme of this 62nd annual summer convention was: "That the Deaf May Speak." Sponsors were the Clarke School for the Deaf, Northampton, Mass., and the Horace Mann School for the Deaf, Roxbury, Mass. I was present at the Boston meetings only.

Although there is still much which I don't know about braille, I blithely believe that I have managed to evolve a rather unique method of coding visible speech for finger reading. Louis Braille's original symbols are given revised interpretations in this system of braille notation. These new allocations permit our braille phonetic version of recorded messages to portray a tactile picture-analysis of the visible speech pattern.[1] The purpose of this paper is to publicize the underlying principles of this proposed phonetic[2] and numerical code.

When it became evident to me that the braille combinations[3] blended very harmoniously with the phonetics formula which I had devised, I tried to discover how those concerned with instructing the blind might react to any suggestion pertaining to possible clarification of the braille code. Being advised that the American Joint Uniform Braille Committee would be interested in making a study of these proposals, I offer them in the following pages of this paper.

For those who are unacquainted with the speech symbols of the International Phonetics Association I strongly recommend consulting the new and completely revised (1952) edition of Margaret Prendergast McLean's, Good American Speech. It is published by E.P.Dutton and Company, New York. For technical data on visible speech experiments, see Potter, Kopp & Green, Visible Speech, and Harvey Fletcher, Speech and Hearing in Communication (D. Van Nostrand Company, Inc., New York.)

1-Common characteristics of related speech sounds are manifest by similar dot formations. The basic phonetic principles of visible speech are closely integrated with physiological phonetics. (B-1415,pp.74-89).

2-Sir Clutha Mackenzie, one of the world's outstanding blind men, and an authority on braille codes, has long advocated the principle of sound in the transcription of braille. Cf.Outlook for the Blind,1946,pp.227-229, & 256-259.

3-The braille cell contains 6 units of points or dots. Speech engineers consider as ideal the set-up of a language which is communicable through a simple system of only 6 elements.

mation of dots in each vertical column constitute the symbols with call numbers divisible by 9. They form a diagonal from the top left corner to the lower right. The other diagonal consists of the multiples of 7. If you were to crease the 8-line symmetry pattern diagram along the diagonal running from zero to symbol #63, so that symbol #7 overlaps symbol #56, all reverse combinations will be found to coincide.

Now we shall explain the technique employed in giving new interpretations to the symbols.

Distribution of the 63 braille combinations:

46 phonetic symbols
- 1-dot cells.... 6
- 2-dot " 13
- 3-dot " 16
- 4-dot " 8
- 5-dot " 3

Total: 46

10 number digits

7 punctuation signs (in phonetic code)

63

(In our orthographic code, where correct spelling is essential, 26 letter signs are required. 25 of these are the same as their phonetic equivalents and one is taken from the punctuation code.)

PHONETICS IN BRAILLE - The braille units conform rather neatly with the vowel and consonant speech charts for linguistic elements of the Western world. Each of the main speech sounds is symbolized in our code by one particular cell combination and no other, so that a sightless person knowing this code, should have no difficulty in approximating the verbal interpretation of the words represented --even though he has never heard them pronounced. The compiler of the code believes that his product also supplies a visible speech pattern useful especially to the deaf-blind. The same would apply to the sighted totally deaf who have a knowledge of this "brand" of braille.

Without exception, each speech sound is classified in a category easily identifiable by the number of dots in its construction. The vowels fit snugly into special categories. Definite distinguishing features mark all consonants possessing similarities. For example, each pair of voiced and voiceless cognates consist of reverse combinations.

Distribution of the 63 braille combinations:

1-dot cells	6	(is our orthographic code.
2-dot "	15	(where correct spelling is
3-dot "	15	(essential. Each letter also
4-dot "	8	(are required. Six other
5-dot "	7	(are the upper part numb-
total:	63	(ers in the lower part.

10 Number digits -
7 punctuation signs (la phonetic code.)

FONETICS II REALLY - The braille units contain
and consonant speech sounds for linguistic analysis of the
Western world. Each of the basic speech sounds is symbolized
in our code by one particular cell combination and we "hear"
as that cell-aidless person thinking this code, should have no
difficulty in approximating the vowel and consonant sounds of the
words represented --even in the more uncommon combinations
noticed. The computer of the code retrieves that information
also supplies a visible speech pattern useful especially to
the deaf-who have a knowledge of this "tonal" or braille.

Without exception, each speech sound is identified in a
memory easily identifiable by the number of dots in its
construction. The vowels fit simply into special categories
telling distinguishing features such as consonants possess-
ing similarities. For example, when pair of voiced and
voiceless consonant sounds of reverse configurations.

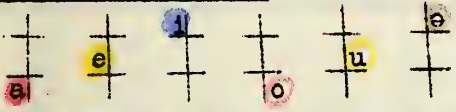
Classifying the Speech Sounds:

(1) The 5 fundamental Latin vowels are represented by a single dot. The 6th dot functions as a vowel modifier (& the schwa).
(2) All other vowel sounds have 2 dots.
(3) The transitionals (semi-vowels and semi-consonants) and the non-fricative consonants each engage 3 dots.
(4) The fricative consonants comprise 4 dots each.
(5) The affricates are made up of 5-dot combinations.

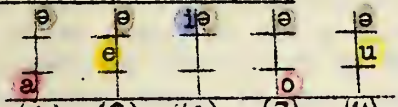
In the following charts the phonetic symbols of the International Phonetics Association are employed to indicate dot positions and sounds represented.

Key to Vowel Code:

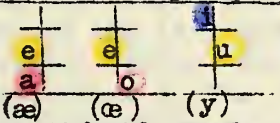
I- The one-dot cells - - - - - - The 5 fundamental Latin vowels and the schwa. The schwa is an unstressed vowel-sound when not connected with another vowel.



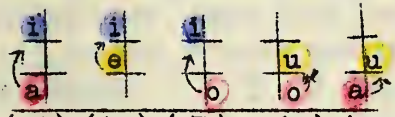
II- The two-dot cells - - - - - - The short vowels, hybrid vowels and rising diphthongs.



Modified vowels



Hybrid vowels -These are crosses between two pure vowels. We form them by employing both sounds concerned.



Rising Diphthongs - result of an elision between two of the fundamental vowels as shown.

NOTE: The IPA symbol (ɜ:), peculiar in many ways, can be represented, for all practical purposes, by the symbol for the hybrid vowel (œ)- which is foreign to English.

COMPOUND CELLS - The French nasal vowels may be formed by two successive vowel signs, the first being the modifier and the other the nasalized vowel.

The so-called <u>falling diphthongs</u> are the result of a glide from a vowel to a semi-vocalic "r-colore sound. Since they actually consist of two successive vowel sounds interrupted by a kind of constriction, we thought of designating them by two successive cell formations, namely 1) the vowel concerned, and 2) the modifier. The "a" sound in such words as "ask" and "after" may always be correctly spoken as "ɑ"- but in large areas it is preferable to voice it as "a." It is represented in our system by the addition of the vowel modifier in a cell following the vowel in symbol #1. (In languages not employing our vowel in symbol #33, there would be no need of this compound cell distinction.) See latest revisions of IPA for the new symbol (ɑ). → =[ʌ]

<u>III- The three-dot cells</u> - - - The transitionals. These comprise the semi-vowels <u>r</u>, <u>j</u>, and <u>w</u>, and the aspirated semi-consonants <u>ʍ</u>, <u>h</u>, and <u>x</u>. Thus:

(r)	(j)	(w)	(ʍ)	(h)	(x)
o· o· o·	·o ·o ·o	o· o· ·o	·o ·o o·	·o oo ··	·· oo ·o

The non-fricative consonants also have a total of 3 dots each, one of these being on one side and two on the other. The voiceless cognate is identified by the top dot on the left side. Its vibrated counterpart is the reverse in braille print. The nasal consonants have the same left-column composition as the vibrated cognate, but each nasal employs the middle right dot as a distinguishing mark. The only lateral consonant in this code, the sound (l), is the reverse combination of braille symbol (n).

VOICELESS	VOICED			
o· ·o (k)·o	·o o· (g)o·	·· oo o· (ŋ)		Soft palate
oo ·· (t)·o	oo ·· (d)o·	o· ·o o· (n)	·o o· ·o (l)	Alveolar (gum ridge)
oo ·o (p)··	oo o· (b)··	o· oo ·· (m)		Bi-labial
		Nasal	Lateral	

IV- The four-dot cells - - - The fricatives. These may be either dental or sibilant (hissing). All dentals have 2 upper dots together on one side. Again the voiceless symbol is the reverse of its vibrated cognate. The sibilants have 3 of the 4 dots on one side :

DENTAL			SIBILANT		
⠤	⠤		⠶	⠶	Copy-
⠶	⠶		⠤	⠤	right
⠠	⠠		⠦	⠦	1953
f	v		ʃ	ʒ	by
⠶	⠶		⠤	⠤	A.
⠤	⠤		⠶	⠶	Henry
⠠	⠠		⠤	⠤	
θ	ð		s	z	

V- The five-dot cells - - - The affricates which are common to IPA and Esperanto. Each of these "meshed" sounds contains a sibilant and hence can readily be recognized by the full column of 3 dots on one side :

⠶	⠶	⠤
⠶	⠶	⠶
⠤	⠤	⠶
tʃ	dʒ	ts

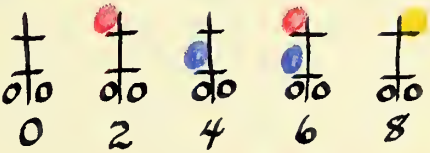
ANOTHER BRAILLE ALPHABET ? - To suggest drastic revisions in the present braille alphabet, is perhaps unwise. Experience has proven that there is bound to be much opposition against any radical changes in the existing set-up. Notwithstanding that fact, the compiler of the foregoing braille phonetic code can hardly refrain from indicating how this phonetic code is conveniently convertible to our 26-letter alphabet for braille writing according to spelling.

It is, of course, up to the authorities concerned with braille to decide whether our technique of transcribing in braille deserves encouraging. It is the author's contention that his code lessens the labor required of would-be transcribers and readers in mastering the multiple connotations and combinations of ciphers in the current code.

Henry's Proposed Braille Numeric Code:-

Key:

2 8
4 1



Digit values of Upper case dots.

Each odd number comprises preceding numeral plus the 1-dot.

Blueprint of 8-line symmetry plan for coding visible speech and numeric symbols in braille.

VISIBLE SPEECH FORMULA FOR BRAILLE

A Braille Coding Technique based on a vertical and horizontal symmetrical pattern of the conventional symbols. This outline includes a proposed numeric and phonetic code adaptable for international use. Suggestions for an orthographic and a punctuation code are also enclosed.

It is the compiler's belief that this plan conforms with requirements recommended in the definition of world braille as drafted at the UNESCO World Braille Conference held in March, 1950.

* *

This is a copy of the original report issued the 6th of January, 1954, and respectfully submitted to THE AMERICAN JOINT UNIFORM BRAILLE COMMITTEE for their appraisal.

The immeasurable energy entailed in "hatching" it is joyfully dedicated to the blind, the deaf, their guardian-angel instructors and braille transcribers everywhere.

---Anthony S. Henry, O.S.A.,
3103 Arlington Ave.,
New York 63, N. Y.

The article which follows was completed on December 8, 1953, and ready for release at that time. Prior to publication I have contacted several addresses of organizations and institutions better versed on braille matters than I am. In these contacts I have mentioned my conviction that I had evolved a method for coding in braille which seems to possess distinct advantages over the conventional system. I requested references and any sort of information which would enable me to discern the desirability of braille authorities for any such suggestions as disclosed herein. I am happy to say that the response from every direction was exhilarating. It is, therefore, for me a genuine pleasure to make public these findings on the 102nd anniversary of Louis Braille's transition from this vale of darkness to the everlasting clear vision of his Creator, face to face.

Let it be known that the author of this braille coding system has no desire to promote its adoption unless it be sanctioned by the proper authorities. Rightly, he feels that it is the business of braille experts to scrutinize it from their practical and collective viewpoint, to test it -- if they think it feasible to do so, in order that a competent conclusion may be reached as to any merits the scheme may possess. Sometimes it happens that plans look practicable on paper, but they just won't work out -- as, for instance, the sonographic "night writing" of Barbier.

If this sincere effort to contribute in some way toward the alleviation of the situation of the sightless does no more than give someone else a clue to a better idea yet, then its publication has served a good and useful purpose.

Comments you may wish to make concerning this proposed formula for brailling visible speech in phonetic symbols and numbers in mathematical symbols should not be addressed to the author, for he is only a novice at braille. Please channel your reactions to the enclosed "formulae" to recognized representatives engaged in the wonderful work of instructing the blind.

ANTHONY S. HENRY, O.S.A.
January 6, 1954

BRAILLE CODING BASED ON AN 8-LINE SYMMETRY

A code is a system of communication in which certain meanings are attributed to signs or symbols. In this paper we are attempting to demonstrate an improved method of coding the 63 standard symbols of the braille system of notation. Our proposed code interpretations have been derived by means of mathematical calculations honoring the interrelationship among the elements concerned. With this code there is no need of a complex set of rules governing lower sign usage, such as presently exists in Standard English Braille, Grade 2.

The figure at the left represents one column of a braille cell. T is the top dot; M - the middle dot; B - the bottom dot. If we include the possibility of a blank column, we find that there are eight different arrangements which can be portrayed by the various permutations of the 3 dots. By mating each of these 8 one-column symbols with each of the same symbols in the neighboring column, we soon discover that it is possible to construct 63 different combinations. This is the result of multiplying all the possibilities in one column with all the possibilities in the other column, minus the one which represents a blank in both columns. The latter, having no dots, cannot be a symbol. It is an empty cell or space.

Naming the Symbols For purposes of identification, let's assign a call number to each of the 63 symbols. This number will be known as the "symbolic value" of the individual ciphers. It should not be confused with the numerical digits in our mathematical code. Permutations of the dots in the left column are evaluated as follows:-

LEFT—RIGHT	
4	32
2	16
1	8

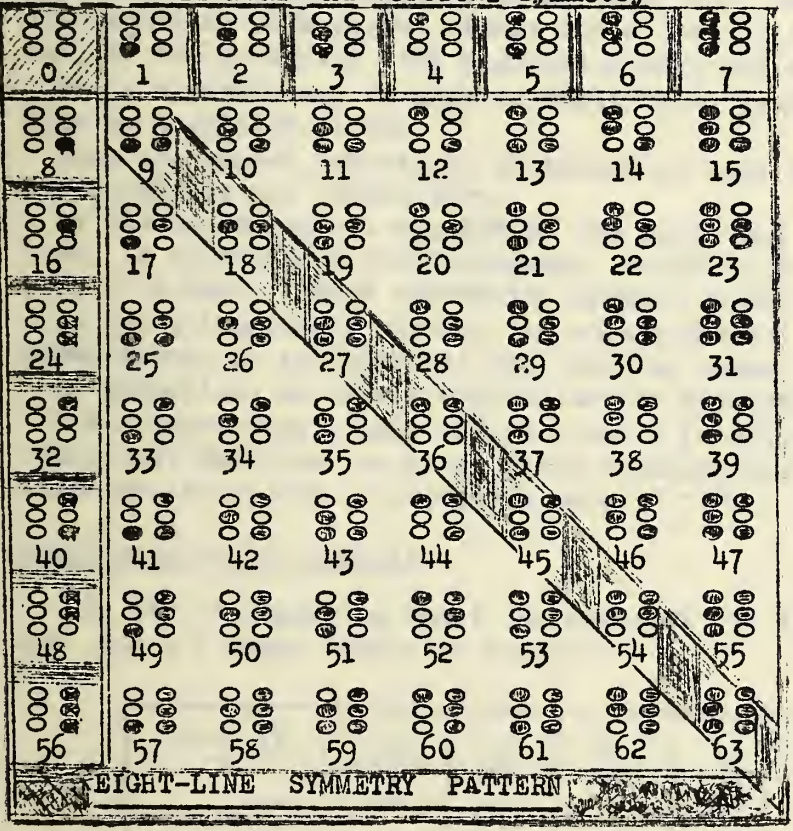
Braille Cell

Dot Combination	-	Symbolic Value
B	. . . . .	1
M	. . . . .	2
B+M	. . . . .	3
T	. . . . .	4
B+T	. . . . .	5
M+T	. . . . .	6
B+M+T	. . . . .	7

The "symbolic value" of the formations involving the right column may be determined by continuing the sequence with the bottom dot equal to 8. It should be noted that each of the dots in the right column has a symbolic value which is 8 times that of the same dot in the left column.

To obtain the "call number" or "number-name" of any of the 63 braille characters, simply add together the dot values in both columns. (It is by no means necessary to remember these identification labels).

Diagram demonstrating the adaptability of the braille symbols to horizontal and vertical symmetry



Numbers in the diagram indicate the "symbolic value" of the individual ciphers. For consecutive order of the dot-combinations, read across, from left to right, beginning with the top line. The left column contains those symbols numbered in multiples of 8. Braille cells composed of an equal nu-

The "symbolic value" of the formation involving the right column may be determined by counting up the sequence with the bottom dot equal to 8. It should be noted that each of the dots in the right column has a symbolic value which is 8 times that of the same dot in the left column.

To obtain the "cell number" or "number-name" of any of the 63 braille characters, simply add together the dot values in both columns. (It is by no means necessary to remember these identification labels).

Diagram demonstrating the adaptability of the braille symbols to horizontal and vertical symmetry

Figure in the diagram indicate the "symbolic value" of the individual cipher. For consecutive order of the dot-combinations, read across, from left to right, begining with the top line. The left-hand portion shows symbols rendered in multiples of 8. Braille cells composed of equal for-

PUNCTUATION SIGNS - - - The following suggestions are offered by the composer of this system as guides in establishing a punctuation code:

Affirmative sentences ought to open and close with the same symbol. At the beginning of a sentence, it is interpreted as a capital sign; at the close of a statement, it is the period.

An exclamatory phrase opens with the same symbol as does an affirmative phrase, but closes with the symbol for phonetic wh.

Questions begin and terminate with an identical symbol. This has many advantages. It is simple for a transcriber to remember that in typing braille-written questions, the ?-symbol at the beginning of a phrase stands for a capital letter. In Spanish, it would signify both a question-mark and a capital letter.

As in typewriting, we make no distinction between opening and closing quotation marks.

When the symbol for single quotation is used in mathematics, it represents the "equal" sign.

If the hyphen symbol appears at the beginning of a braille line, it indicates a poetic passage. A double hyphen is equivalent to a dash. Three successive hyphens symbolize an ellipsis.

In our orthographic system, the apostrophe is the same as the schwa-symbol in the phonetic code and the comma in mathematics.

In phonetics, neither a capital nor an apostrophe are needed.

* * * There remain many unused symbols (mostly the 2-dot combinations) which can be given other designations in the punctuation system of our orthographic code. * * *

Basic punctuation symbols :

In the accompanying chart, an asterisk (*) indicates a braille dot, and s-v means "symbolic value" :-

s-v: 18	54	43	45	47	61	63
**	**	*	**	**	**	**
	**	**		*	*	**
			**	**	**	**
hyphen	single quotation	phonetic sign	comma	?	affirm. start & stop	"

HENRY'S PROPOSED CODE - - - Consult the diagram on page 28 for dot-combinations.

In the chart which follows, s-v stands for "symbolic value";
Orth. " " alphabetic letter;
Num. " " numerical digit;
IPA " " phonetic value in International Phonetics Association ciphers;
Punct. stands for punctuation sign.

s-v	Orth.	Num.	IPA	Punct.
0				space
1	A.		ɑ	
2	E.		e	
3			æ	
4	I.	⠨	i	decimal point
5			ɑ̃	
6			ẽ	
7	R.		r	
8	O.		o	
9		0		
10			œ	
11		4		
12			õ	
13		2		
14	W.		w	
15		6		
16	U.		u	
17			ɑ̃	
18				hyphen
19			ŋ	
20			ʏ	
21	N.		n	
22	M.		m	
23	Z.		z	
24			œ̃	
25		1		
26	X.		x	
27		5		
28	K.		k	
29		3		
30	V.		v	
31		7		

s-v	Orth.	Num.	IPA	Punct.
32		⠠	ə	apostrophe
33			ʌ	
34			ɛ	
35	G.		g	
36			ɪ	
37	D.		d	
38	B.		b	
39	J.		ʒ	
40			ɔ	
41		8		
42	L.		l	
43				phonetic sign
44	T.		t	
45				comma
46			ɔ̃	
47	Q.			question mark
48			u	
49			ʌ̃	exclamation
50	H.		h	
51	F.		f	
52	P.		p	
53			θ	single
54		⠶		quotation mark
55			dʒ	
56	Y.		j	
57		9		
58	S.		s	
59	C.		ʧ	
60			ʃ	
61				capital and
62			ʧ	period
63				Double quotatio

McKAY'S PROPOSED CODE - - - Consult the diagram or page 8 for dot-combinations.

In the chart which follows, a-v stands for "symbolic value":

Ortho. " " alphabetic letter;
Num. " " numerical digit;
IPA " " phonetic value in International Phonetics Association alphabets;
Punct. stands for punctuation sign.

a-v	Ortho.	Num.	IPA	Punct.	a-v	Ortho.	Num.	IPA	Punct.
0				space	32				
1	A				33				
2	E				34				
3					35				
4	I				36				
5					37				
6					38				
7					39				
8	O				40				
9					41				
10					42				
11					43				
12					44				
13					45				
14	U				46				
15					47				
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BIBLIOGRAPHY - - After preparing the foregoing material, I was reluctant to release it until I could make a thorough check on earlier attempts to clarify the code, to minimize the hazards, to eliminate the static, in the braille system of communication. I found the following material especially helpful:-

1932 - W. Percy Merrick & W. Potthoff : A Braille Notation of the International Phonetic Alphabet.

1934 - Harry Best : Use of Raised Print by the Blind. This the 36th chapter of his book, Blindness and the Blind.

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1947 - John Sargent : Report of the Expert Committee of the Central Advisory Board of Education on Uniform Indian Braille.

1948 - P. M. Advani : Braille - What it is and How it has been used.

1949 - Sir Clutha Mackenzie's Report on the World Braille Situation - prepared at the request of UNESCO.

1950 to 1953 - All articles on braille problems in these volumes of: International Journal for the Education of the Blind; The New Beacon; and Outlook for the Blind.

1953 - Abraham Nemeth : Nemeth Code of Braille Mathematics.

1953 - F. W. MacKenzie : Braille Printing and the Periprinter. This article in the Primrose Annual (1953) describes the new electronic "sensing machine" now in use for printing "solid dot braille" in plastic ink on both sides of tissue-thin paper. It mentions former embossing systems.

* *

For the gracious assistance in obtaining these and several other references I am grateful to the Librarians at the following addresses in New York city :-
American Foundation for the Blind;
The Jewish Braille Institute of America;
The Library for the Blind (a branch of the N Y Public Library);
The New York Institute for the Education of the Blind;
United Nations Library.

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BIBLIOGRAPHY - - After studying the foregoing material, I was reluctant to relinquish it until I could make a thorough study of earlier attempts [illegible] the [illegible] in the braille system of [illegible]. [illegible] having selected especially helpful [illegible].

1902 - [illegible] : [illegible] of the [illegible] Braille Alphabet.

1895 - Henry [illegible] : [illegible] in the blind. [illegible] the [illegible] of his [illegible] [illegible] [illegible]

[illegible] : [illegible] and [illegible]

1917 - [illegible] : Report of the [illegible] of the [illegible] Braille [illegible] [illegible] [illegible] English.

19[illegible] - [illegible] : [illegible] Braille [illegible]

1926 - Sir Clutha Mackenzie : Report on the [illegible] English [illegible]

[illegible] - [illegible] [illegible] : [illegible] for the [illegible] [illegible] the [illegible] [illegible]

1935 - [illegible] : [illegible] of English [illegible]

1937 - [illegible] : [illegible], English and the [illegible] [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible]

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[illegible] : The [illegible] of this report [illegible] [illegible] [illegible] of the [illegible] as they [illegible].